

Subpart E—Gaseous Exhaust Test Procedures**§ 91.401 Scope; applicability.**

(a) This subpart describes the procedures to follow in order to perform exhaust emission tests on new marine gasoline-fueled spark-ignition propulsion engines subject to the provisions of subpart A of this part 91. Provisions specific to raw gas sampling are in §§ 91.414 through 91.419, provisions specific to constant volume sampling are in §§ 91.420 through 91.426. All other sections in this subpart apply to both raw gas sampling and constant volume sampling unless indicated otherwise.

(b) Requirements for emission test equipment and calibrating this equipment are found in subpart D of this part.

§ 91.402 Definitions.

The definitions in §§ 91.3, 91.102, and 91.302 apply to this subpart.

§ 91.403 Symbols and abbreviations.

(a) The abbreviations in § 91.5 apply to this subpart.

(b) The symbols in Table 1 in appendix A to subpart D apply to this subpart.

§ 91.404 Test procedure overview.

(a) The test consists of prescribed sequences of engine operating conditions to be conducted on an engine dynamometer or equivalent load and speed measurement device. The exhaust gases generated during engine operation are sampled either raw or dilute, and specific components are analyzed through the analytical system.

(b) The tests are designed to determine the brake-specific emissions of hydrocarbons, carbon monoxide, and oxides of nitrogen. The test consists of one idle mode and four power modes with an exponential relationship between torque and speed which span the typical operating range of spark-ignition marine propulsion engines. These procedures require the determination of the concentration of each pollutant, fuel flow, and the power output during each mode. The measured values are weighted and used to calculate the

grams of each pollutant emitted per brake kilowatt hour (g/kW-hr).

(c)(1) When an engine is tested for exhaust emissions the complete engine is tested, with all emission control devices installed and functioning.

(2) Additional accessories (for example, oil cooler, alternators, and so forth) may be installed, but such accessory loading will be considered parasitic in nature and observed power is used in the emission calculation.

(d) All emission control systems installed on or incorporated in the application must be functioning during all procedures in this subpart. In cases of component malfunction or failure, no maintenance is allowed without prior approval from the Administrator in accordance with § 91.118.

§ 91.405 Recorded information.

(a) Record the information described in this section for each test where applicable.

(b) *Test data; general.* (1) Engine identification number.

(2) Engine emissions control system.

(3) Test operator(s).

(4) Number of hours of operation accumulated on the engine prior to beginning the warm-up portion of the test (to the nearest tenth hour).

(5) Fuel identification.

(6) For two-stroke engines, fuel/oil mixture ratio.

(7) Date of most recent analytical assembly calibration.

(8) All pertinent instrument information such as tuning, gain, serial numbers, detector number, and calibration curve numbers. As long as this information is traceable, it may be summarized by system number or analyzer identification numbers.

(c) *Test data; pre-test.* (1) Date and time of day.

(2) Test number.

(3) Barometric pressure; as an option, barometric pressure can be measured as a modal measurement instead of or in addition to a pre- and post-test measurement.

(4) Recorder chart or equivalent. Identify for each test segment zero traces for each range used, and span traces for each range used.

(d) *Test data; modal.* (1) Recorder chart or equivalent. Identify for each

test mode the emission concentration traces and the associated analyzer range(s).

- (2) Observed engine torque.
- (3) Observed engine rpm.
- (4) Engine intake air flow, if applicable.
- (5) Test cell temperature and humidity for each mode.
- (6) For raw gas testing; fuel flow for each mode. Fuel flow measurement is not required for dilute testing but is allowed. If the fuel flow measurement is a volume measurement system, record the fuel temperature in the measurement system for fuel density corrections to the mass flow rate. If the fuel temperature is within 3 °C of the calibration temperature, no density correction is required.
- (7) Engine intake temperature and humidity for each mode, if applicable.
- (8) Exhaust sample line temperature, if applicable.
- (e) *Test data; post-test.* (1) Recorder chart or equivalent. Identify the hang-up check.
- (2) Recorder chart or equivalent. Identify the zero traces for each range used and the span traces for each range used.
- (3) Total number of hours of operation accumulated on the engine (to the nearest tenth hour).
- (4) Barometric pressure, post-test segment.

§ 91.406 Engine parameters to be measured and recorded.

Measure or calculate, then record, the engine parameters in Table 1 in appendix A of this subpart.

§ 91.407 Engine inlet and exhaust systems.

- (a) The marine engine manufacturer is liable for emission compliance over the full range of restrictions that are specified by the manufacturer for that particular engine.
- (b) The air inlet filter system and exhaust muffler system combination used on the test engine must be the systems expected to yield the highest emission levels.

§ 91.408 Pre-test procedures.

- (a) *Engine service accumulation and stabilization procedure.* Use the service

accumulation procedure determined by the manufacturer for exhaust emission stabilizing of an engine, consistent with good engineering practice (see § 91.117).

- (1) The manufacturer determines, for each engine family, the number of hours at which the engine exhaust emission control system combination is stabilized for emission testing. However, this stabilization procedure may not exceed 12 hours. The manufacturer must maintain, and provide to the Administrator upon request, a record of the rationale used in making this determination. If the manufacturer can document that, at some time prior to the full 12 hour service accumulation period, the engine emissions are decreasing for the remainder of the 12 hours, the service accumulation may be completed at that time. The manufacturer may elect to accumulate 12 hours on each test engine within an engine family without making this determination.

- (2) During service accumulation, the fuel and lubricants specified in § 91.308 must be used.

- (3) Engine maintenance during service accumulation is allowed only in accordance with § 91.117.

- (b) *Engine pre-test preparation.* (1) Drain and charge the fuel tank(s) with the specified test fuel (see § 91.308) to 50 percent of the tank's nominal capacity. If an external fuel tank is used, the engine fuel inlet system pressure must be typical of what the engine will see in use.

- (2) Operate the engine on the dynamometer measuring the fuel consumption (fuel consumption required only for raw gas sampling method) and torque before and after the emission sampling equipment is installed, including the sample probe, using mode 1 from Table 2 in appendix A of this subpart. The emission sampling equipment may not significantly affect the operational characteristics of the engine (typically, the results should agree within five percent).

- (c) *Analyzer pre-test procedures.* (1) If necessary, warm up and stabilize the analyzer(s) before calibrations are performed.

- (2) Replace or clean the filter elements and then vacuum leak check the